MEMORANDUM

(GR-83)
SSCL-SR-1142

TO: Mack Riddle (RTK) and Chris Laughton (SSCL)
CC: Priscilla Nelson (SSCL)
Ed Kavazanjian
Mahi Galagoda
FROM: Matt Werner and Roger Norris, Earth Technology
DATE: May , 1990
SUBJECT: Results of Examination of Boring Logs and Core Photos for the Distribution of Fracture Zones, Core Disking, and Weathering at the Superconducting Super Collider Site

INTRODUCTION

Boring logs and core photographs made from characterization borings at the Superconducting Super Collider (SSC) site were examined to identify rock properties that could affect construction of the facility.

Over a hundred borings have been made at the SSC site to determine foundation qualities and estimate construction costs. Most borings had nearly continuous core sampling. Weathered rock, fracture zones, and "disking" zones were observed in the cores.

For this study, data on 172 fracture zones were compiled from 78 vertical borings and 71 from 13 angle borings that penetrated faults. In addition, data on 71 core-disking zones were compiled from 33 borings for which there were photographs of the cores. Weathering depths were compiled from 78 borings.

A fracture zone was defined as a depth range containing two or more fractures per foot of borehole. The distribution of fracture zones was examined for relation to strata, by rock type, by zone widths, by thickness of overburden, and by location around the ring. The effect of faults upon the numbers of fracture zones was examined in the angled borings.

A disking zone was defined as a depth range where core has fragmented into short cylinders with length less than diameter.

METHODOLOGY

The source of fracture data and weathering data was the stratum description column of the boring logs. Fractures were described by their depth, rock type, angle of break (dip angle; the strike direction is unknown), and texture of the break surface (i.e., smooth, rough, slickensided). True-depth data for the angled borings were obtained from deviation-survey results. Weathering was described as slight, moderate, or severe; color, hardness, and fragmentation were noted. The source of core-disking data was the color photographs of the cores, with their depth ranges shown on identification placards.

The borings used are listed in the Appendix. This set includes borings of the initial Texas proposal, the RTK drilling program, and the Earth Technology program.

The following information was collected from each core boring log and entered into a data-base file (see Appendix).

- Boring identification
- Coordinates north and east (feet)
- Ground elevation (feet)
- Formation-top depths (feet)

- Total depth of boring (feet)
- Fracture-zone depth ranges (feet)
- Disking-zone depth ranges (feet)
- Weathering depths (feet)

Zones where the fracture density was less than two fractures per foot were not compiled.

ANALYSIS AND RESULTS

Because tunnel construction will involve three rock types over a range of depths around a perimeter, we examined the distribution of fracture zones by rock type, by depth (or overburden), and by tunnel section. In addition, we examined the relation to formations, the distribution of fracture-zone widths, and the effect of proximity to faults. Core-disking was examined for relation to formations.

Fracture Distribution by Rock Type

Figure 1 (bottom) shows the percent of borehole length that is fractured in each rock type. The top graph shows the total length drilled and the middle graph shows the total length fractured. The bottom graph was produced by dividing the middle numbers by the top numbers. Fracturing is seen to be more common in the top 150 feet of the Austin Chalk (given as one of three divisions of the Austin Chalk in the Site Reference Stratigraphic Column [1989]) than elsewhere in the chalk, or in the overlying Taylor Marl. The greatest fracturing, however, is in the underlying Eagle Ford Shale. Over 4 percent of the Eagle Ford Shale encountered in vertical boreholes is fracture zones.

Fracture Distribution by Depth

Figure 2 (bottom) shows the distribution of fracture zones with depth, in 50-foot intervals. The top graph shows the total number of fracture zones by depth and the middle graph shows the number of boreholes penetrating those depths. The bottom graph was produced by dividing the top numbers by the middle numbers. Fracturing is seen to be most common between 200 and 300 feet. However, this distribution is the result of uneven sampling; there was more drilling on the western side of the site, for example, where the Eagle Ford Shale is about 200 feet deep. Also, because of the strata dip, the 200-to-300-foot depth range contains all rock types. Therefore, conclusions should be conservative; such as, the number of fracture zones in a 50-foot interval of the average borehole is between zero and one. Overburden thickness does not seem to be a dominant variable.

Fracture Distribution by Tunnel Section

Figure 3 (bottom) shows the distribution of fracture zones by tunnel section (in eighths) clockwise from the east minor axis of the tunnel ring. The top graph shows the number of fracture zones in each section and the middle graph shows the total length drilled in each section. The bottom graph of the number of fracture zones per kilofoot drilled was produced by dividing the top numbers by the middle numbers. The distribution shows most fracturing in the SW, W, and NW sections and least fracturing in the E section. The most fracturing appears where the Eagle Ford Shale is sampled most. The least fracturing appears where the Taylor Marl is sampled most. The effect of strata dip and rock type appear to shape the distribution.

Fracture Distribution by Stratum

Figure 4 shows the number of fracture zones in each 50-foot interval measured relative to the top of the Austin Chalk. Fracturing appears throughout each stratum, and more near contacts – much more near the Austin Chalk-Eagle Ford Shale contact. Fracture zones in the shale are three times more numerous than those in the immediate overlying chalk.

see Figures 1 thru 4

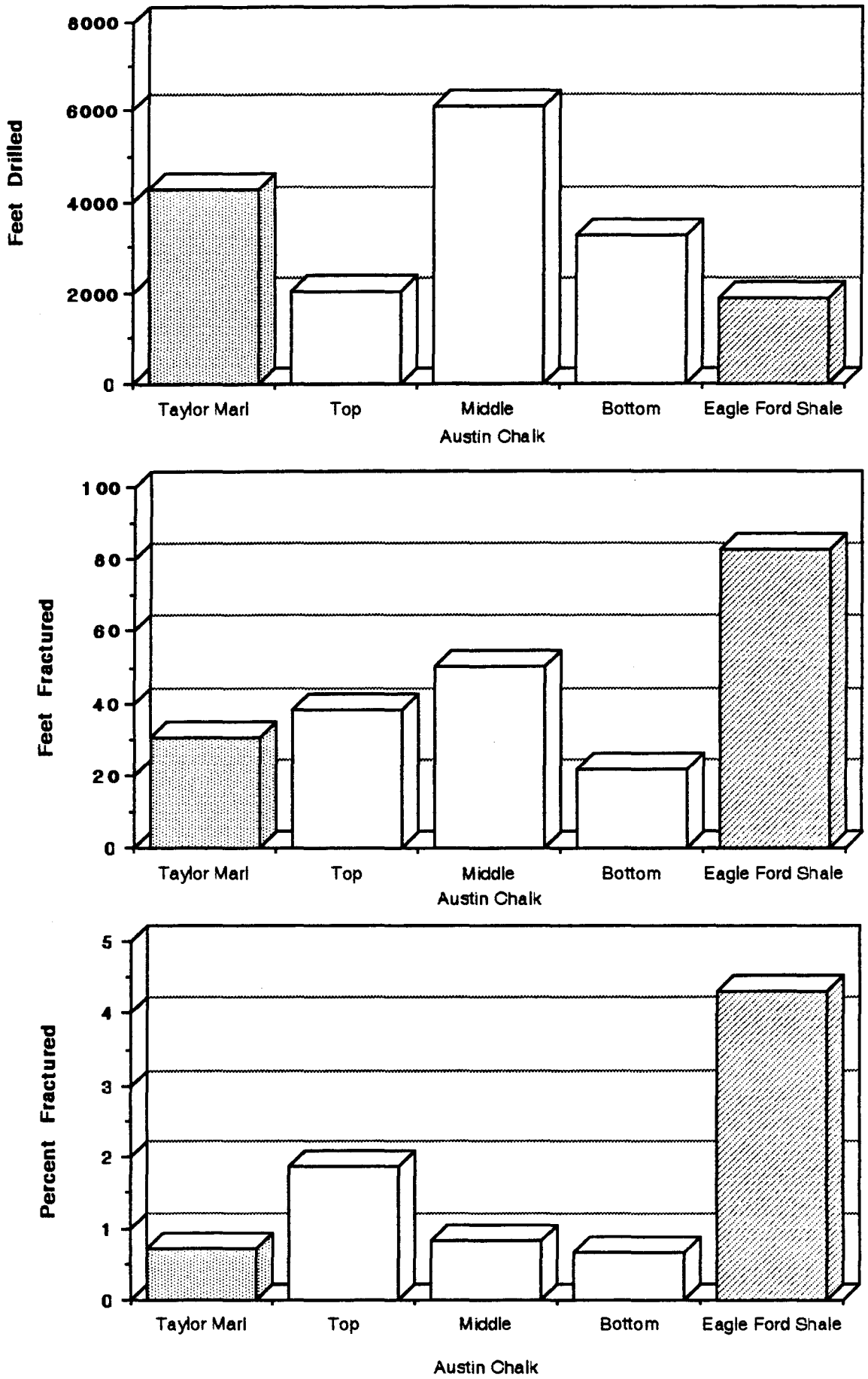


Figure 1. Percent Fractured by Rock Type

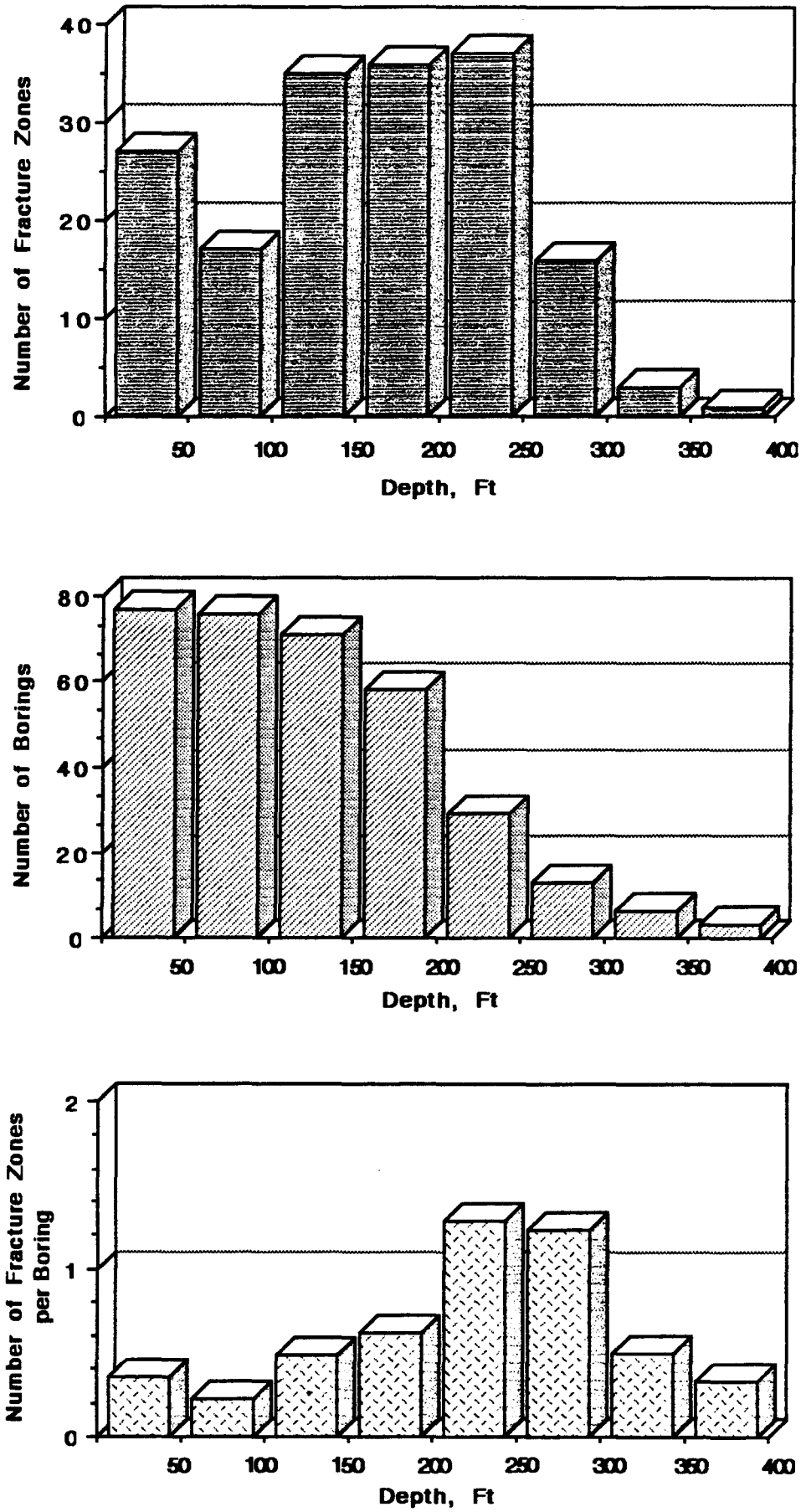


Figure 2. Occurrence of Fracture Zones Versus Thickness of Overburden (Depth)

Figure 5. Number of Fracture Zones Versus their Width

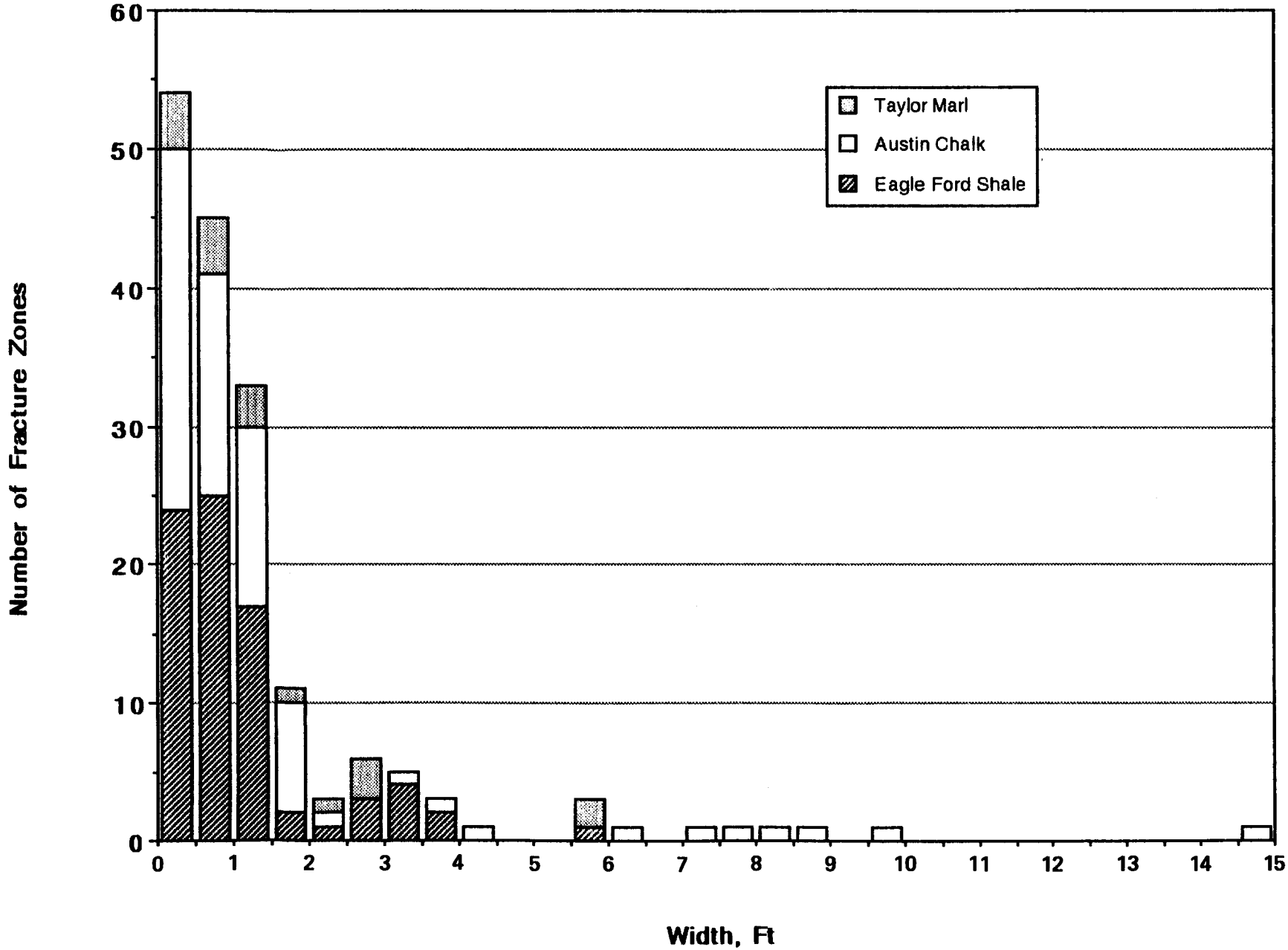
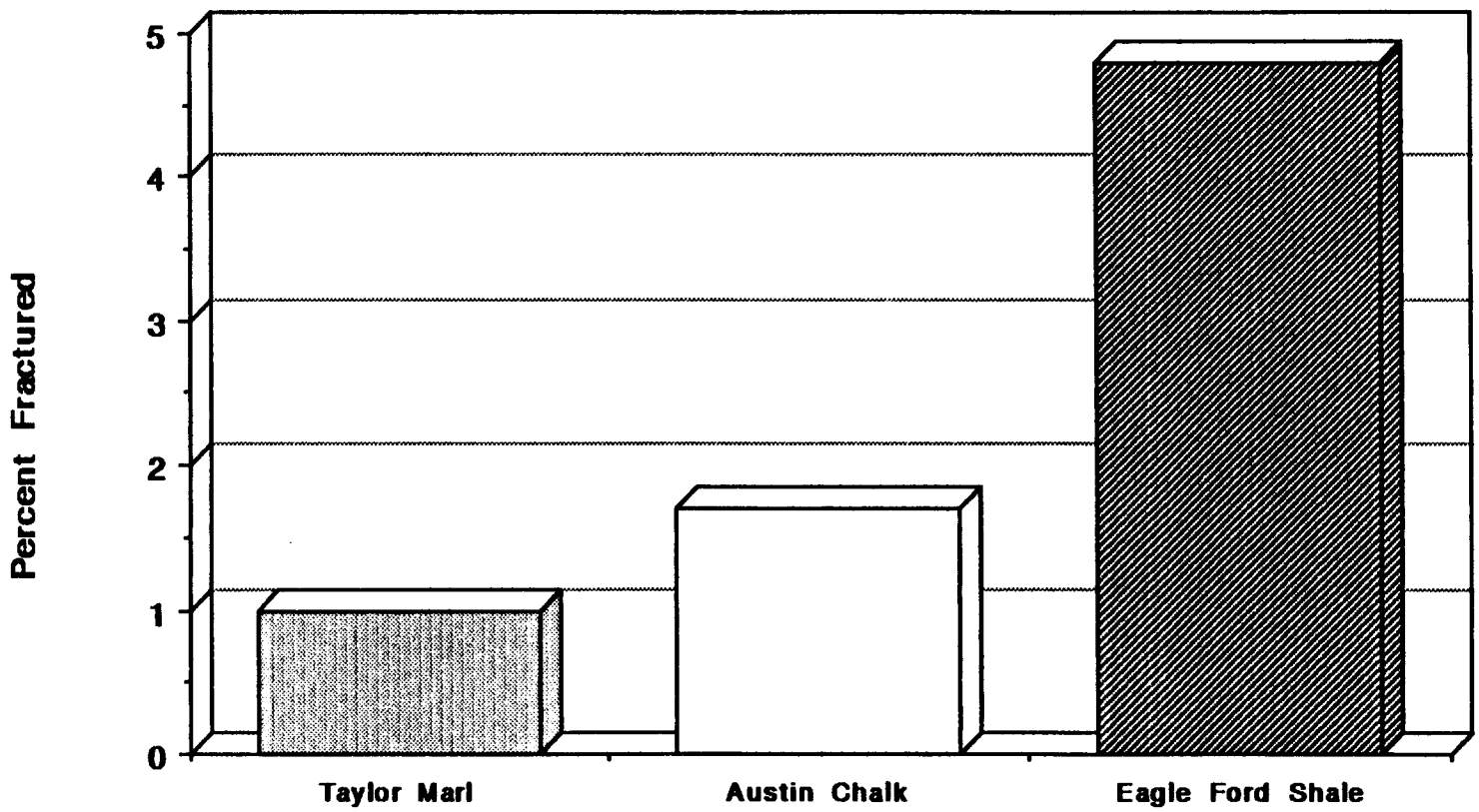


Figure 6. Percent Fractured by Rock Type in 13 Angle-Borings that Penetrated Fault Zones



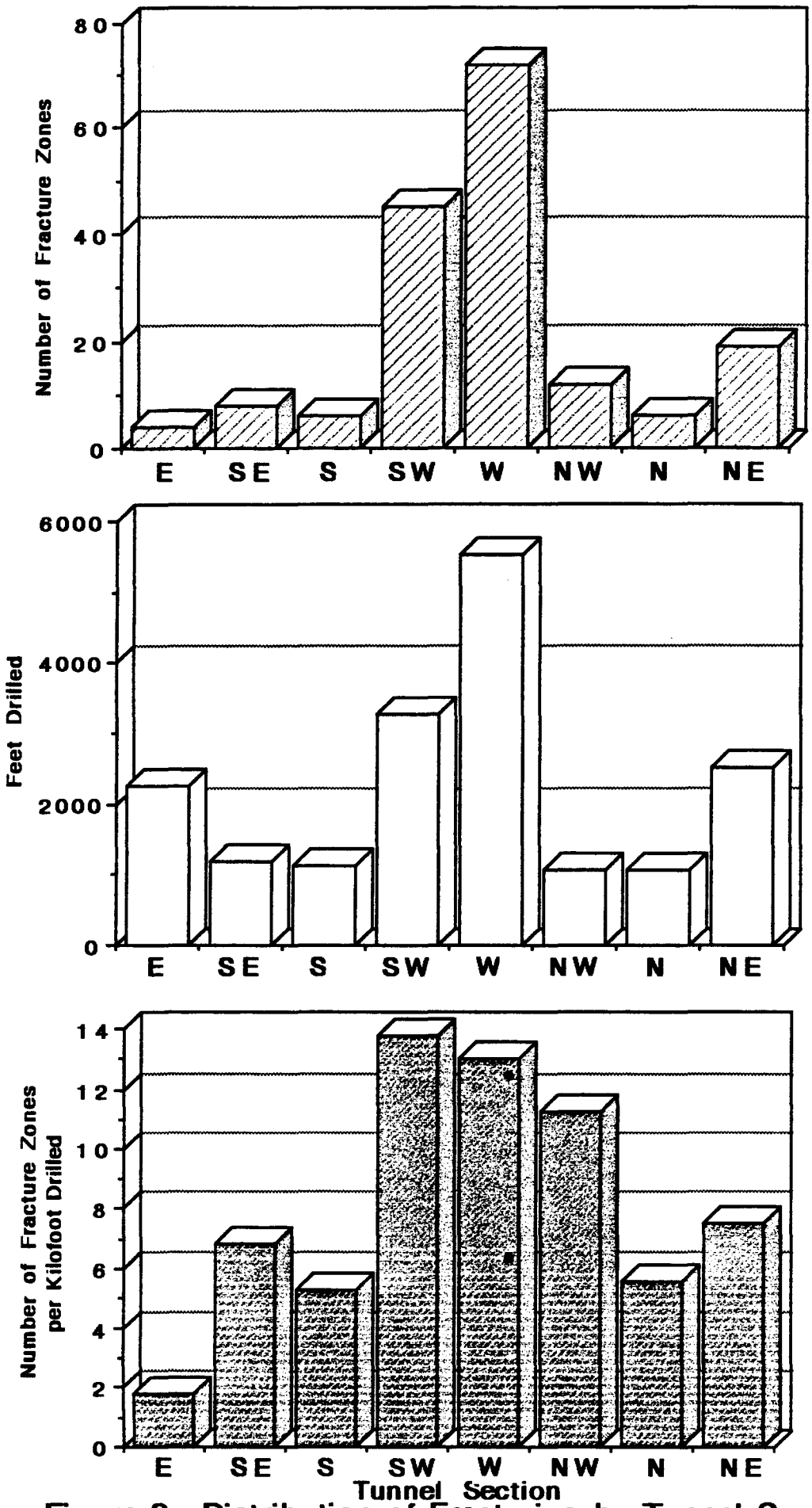
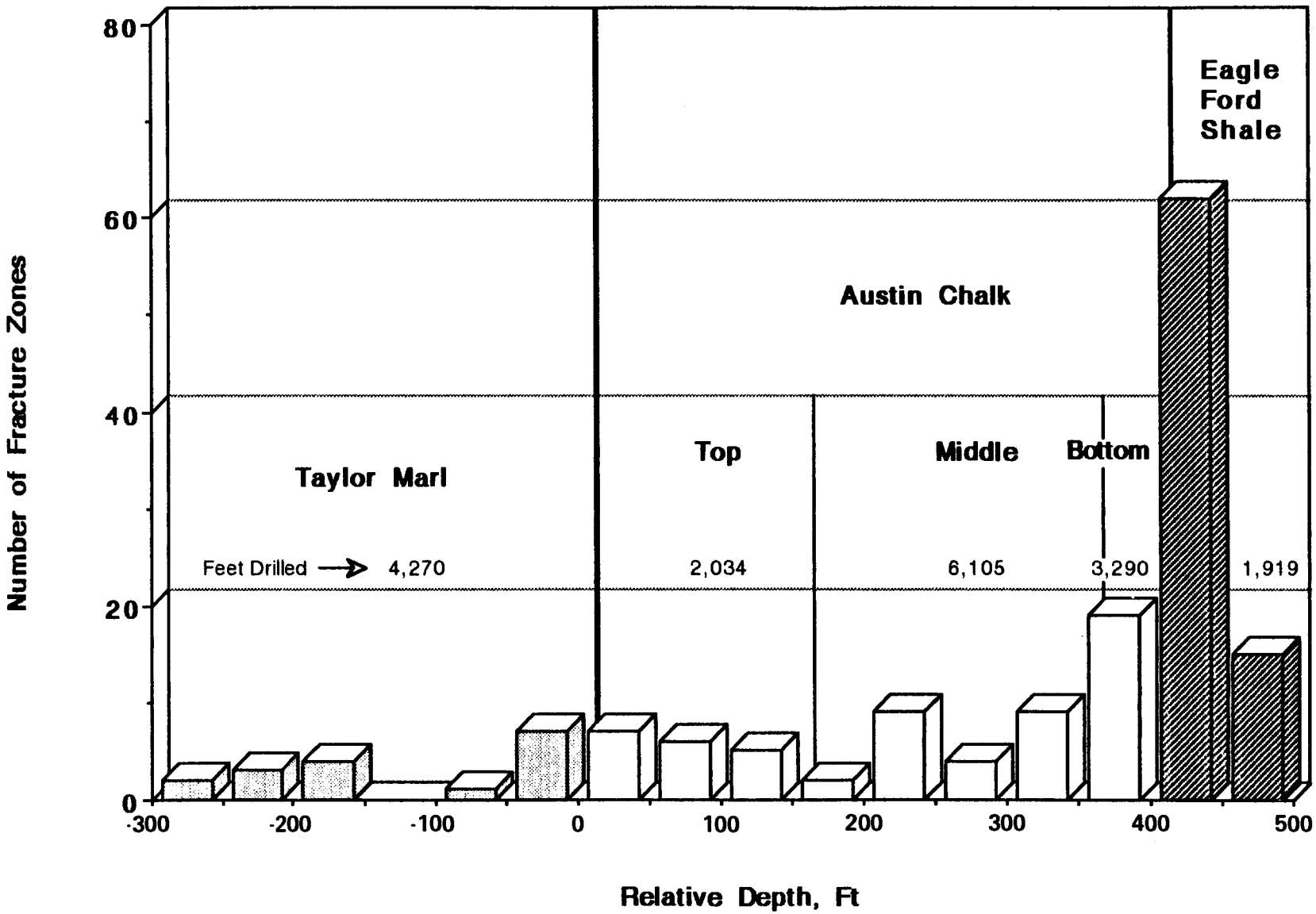


Figure 3. Distribution of Fracturing by Tunnel Section

Figure 4. Number of Fracture Zones Versus Their Depth (relative to top of Austin Chalk), the Formations in Which They Occur, and the Number of Feet Drilled in Each Formation



Fracture Distribution by Zone Width

Figure 5 shows the number of fracture zones versus width of the zone. The narrowest zones are the most numerous; over half are less than 1 foot wide and 84 percent are less than 2 feet wide. Only one observed zone exceeds 10 feet in width. The few wider zones are in the Austin Chalk. These statistics are summarized in Table 1.

TABLE 1. STATISTICS OF FRACTURE ZONE WIDTH

Formation	Width of Fracture Zones (ft)			Percent Fractured	Number of Samples
	Mean	Std. Dev	Max.		
Taylor Marl	1.8	1.7	5.6	0.7	17
Austin Chalk					
- Top	1.9	3.1	14.6	1.9	20
- Middle	2.5	3.1	9.8	0.8	20
- Bottom	1.1	1.5	7.0	0.6	20
Eagle Ford Shale	1.1	1.1	5.9	4.3	73

Fracture Zones in Angled Boreholes that Penetrated Faults

The question was raised whether fracturing is greater in the angled boreholes specifically drilled to penetrate faults. Thus, we examined the distributions of fracture zones by rock type and by zone width.

Percent Fractured by Rock Type. The widths of the fracture zones in the Taylor Marl, the Austin Chalk, and the Eagle Ford Shale in the 13 angled borings were compiled, summed, and divided by the feet drilled in each formation. Figure 6 shows the result (two anomalously wide zones associated with a fault in Boring SE10.9C have been omitted). Fracture zone widths may be narrower than a fault width because core samples containing less than two fractures per foot were not compiled as fracture zones (by definition). Additional statistics are shown in Table 2.

TABLE 2. STATISTICS OF FRACTURE ZONE WIDTH IN 13 ANGLE-BORINGS THAT PENETRATED FAULT ZONES

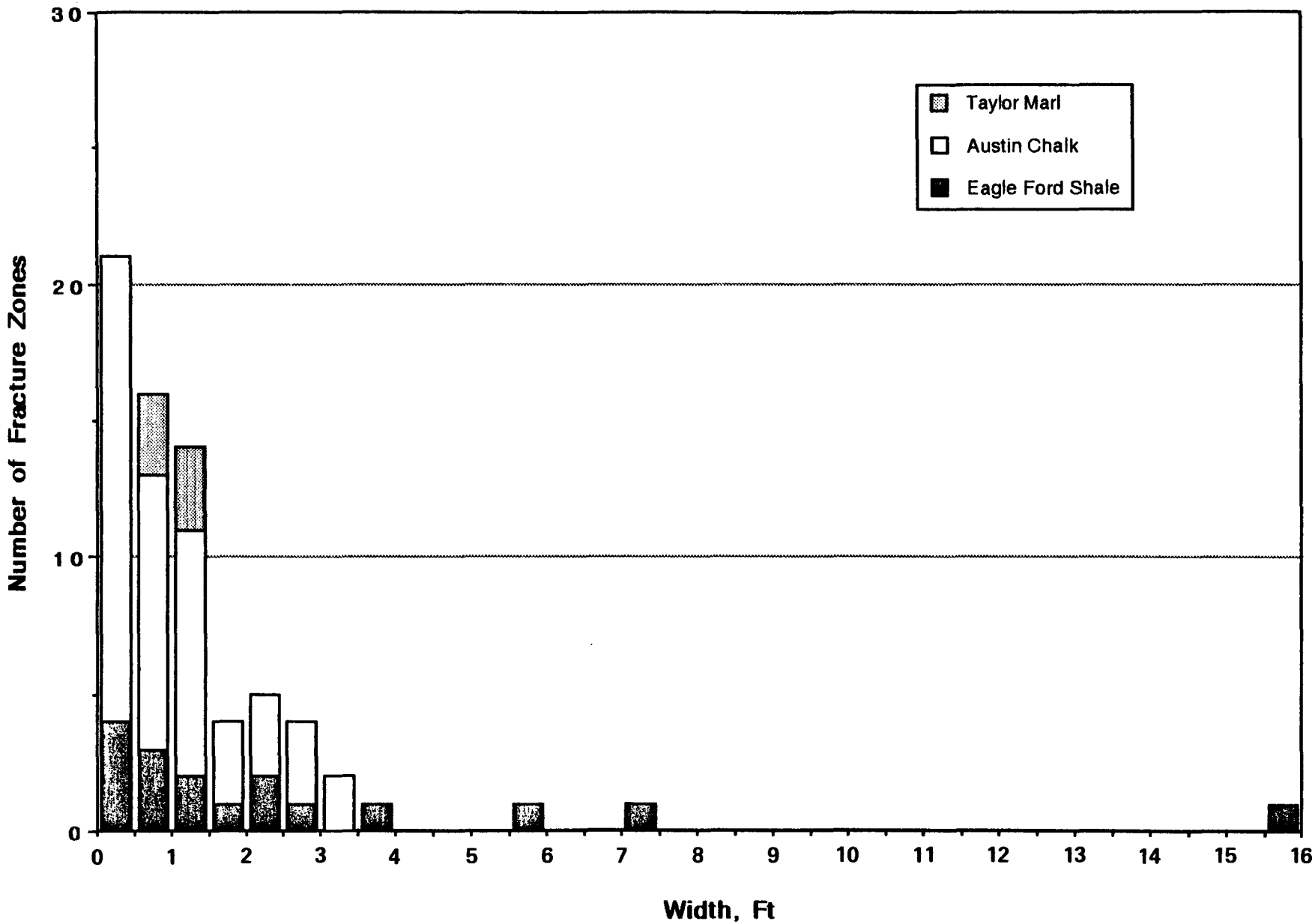
Formation	Width of Fracture Zones (ft)			Percent Fractured	Number of Samples
	Mean	Std. Dev	Max.		
Taylor Marl	1.0	0.3	1.4	1.0	6
Austin Chalk	1.0	0.9	3.4	1.7	47
Eagle Ford Shale	2.0	2.1	7.2	4.8	16

Thus, in the 13 holes that penetrated faults, the percent fractured have the same order of magnitude as those for the other holes. In fact, the Austin Chalk is less fractured for this data set. The mean width and the standard deviation of widths is also of the same magnitude as for the other holes, being actually smaller for the Taylor Marl and Austin Chalk and less than a factor of 2 larger for the Eagle Ford Shale.

Number of Fracture Zones Versus Width in 13 Angle-Borings that Penetrated Fault Zones. Figure 7 shows a fracture-zone width distribution similar to that for the holes that did not penetrate a fault (Figure 5). Thus, there appears to be no reason to expect a greater volume of fracturing in the neighborhood of a fault.

Figure 5 thru 7

Figure 7. Number of Fracture Zones Versus Their Width in 13 Angle Borings that Penetrated Fault Zones



Core Disking Distribution by Stratum

The phenomenon of "core disking", in which rock cores break into a set of hockey-puck-like fragments, has been observed in cores from the SSC site. This effect is possibly produced by regional horizontal stress, which would have implications for tunnel construction.

Thus, we examined core photographs from 33 borings to compile statistics of disking-zone widths and percent of core disked, as shown in Table 3.

TABLE 3. STATISTICS OF DISKING ZONE WIDTH

Formation	Width of Disked Zones (ft)			Percent Fractured	Number of Samples
	Mean	Std. Dev	Max.		
Taylor Marl	6.2	6.6	25.0	4.9	15
Austin Chalk	2.9	3.2	14.0	2.6	48
Eagle Ford Shale	2.6	2.2	6.0	1.8	8

Disking observed in the SSC cores was evident when the core was first removed from the core barrel. The disk breaks are parallel to bedding, and were not noted to be slickensided or mineralized. The disking may be due to stress-relief upon being cored. A comparison of Table 3 data with the data for fracture zones (Tables 1 and 2) shows that the width of disked zones (and their variability) averages 2 or 3 times greater than that for fracture zones. The percent of disked core is less than the percent of fracture-zone core in Austin Chalk. The ratios for Taylor Marl and Eagle Ford Shale are of doubtful value because disking for these formations was observed only in three or four borings.

Figure 8 shows the distribution of disking with depth, where depth is measured relative to the top of the Austin Chalk. Comparison of Figure 8 (disking distribution) with Figure 4 (fracture distribution) shows that disking is more prevalent nearer the top and especially the bottom of the Austin Chalk, while fracturing is greatest near the top of the underlying Eagle Ford Shale. A hypothetical explanation for this relationship may be that stresses were concentrated near the Austin Chalk/Eagle Ford Shale contact during some prior tectonic episode; the shales' long-term response to the stresses was to form zones of fracturing, whereas the chalk retained the residual stress and did not fracture. The observations of core disking and fractured zones near the Austin Chalk/Eagle Ford Shale contact should be confirmed during future drilling.

Depth of Weathering

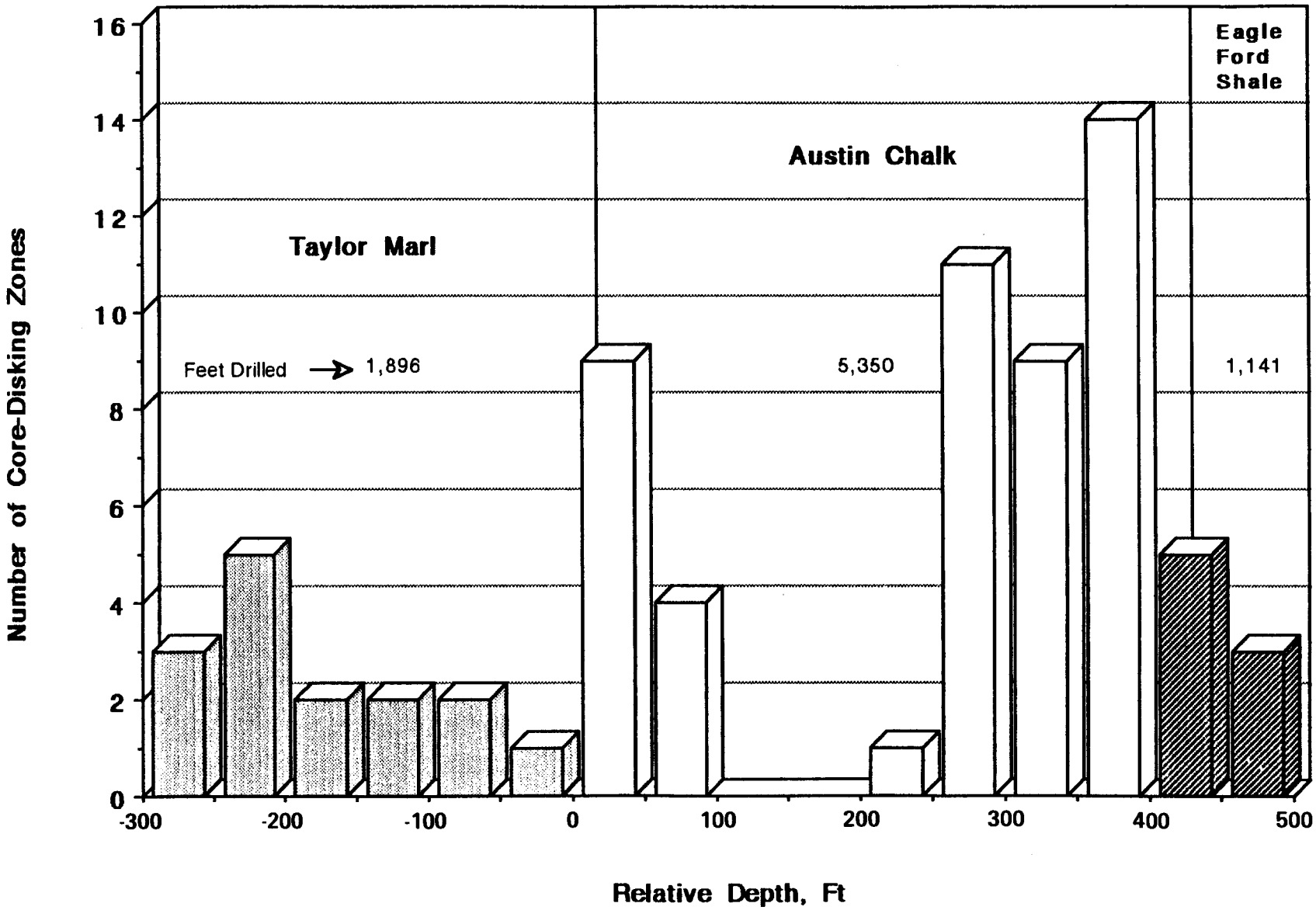
The bedrock on site is usually covered by a layer of soil and clay, and its top is weathered to varying depths. Because weathered rock has very different physical properties than unweathered rock, we examined the weathered layer thickness and its relation to elevation and drainage for Taylor Marl and Austin Chalk. The statistics are shown in Table 4:

TABLE 4. STATISTICS OF WEATHERING THICKNESS

Formation	Thickness of Weathering (ft)				Number of Samples
	Mean	Std. Dev	Max.	Min.	
Taylor Marl	13.1	12.6	44.0	0.0	25
Austin Chalk	8.9	6.5	32.5	0.0	53

Figure 8

Figure 8. Number of Core-Disking Zones Versus Their Depth (relative to top of Austin Chalk) and the Formations in Which They Occur



The table shows that the thickness of the weathered layer averages about 10 feet, although in places it does attain 40 feet. The average thickness for Taylor Marl is about 50 percent greater than for Austin Chalk and its variability is about twice as great.

The boring locations on the topographic map were examined to determine the relation of elevation and drainage to thickness of the weathered layer. No simple relation was apparent. The thickness seems to be a very local response to weathering processes acting on specific lithology.

SUMMARY AND CONCLUSIONS

The distribution of fracture zones is primarily a function of formation and proximity to a formation contact. The Eagle Ford Shale has the most fracture zones and the Top Austin Chalk has the second most zones. The contact between Austin Chalk and Eagle Ford Shale is the stratigraphic location of the greatest concentration of fracture zones, with most in the shale. The number of fracture zones in a 50-foot interval of an average borehole is between zero and one. The width of the fracture zones is likely to be less than 1 foot (58 percent) or 2 feet (84 percent), with the wider zones in the Austin Chalk. The number and width of fracture zones in boreholes that penetrated faults is about the same as boreholes elsewhere.

Core-disking is most prevalent near the bottom of the Austin Chalk whereas fracture zones are most prevalent near the top of the underlying Eagle Ford Shale. This relationship may have implications to rock-performance characteristics.

Weathering depth in the bedrock averages about 10 feet, although in places it is as great as 40 feet. No simple relation to elevation and drainage is apparent.

REFERENCES

The Earth Technology Corporation, November 1989. Superconducting Super Collider Site Reference Stratigraphic Column, prepared for RTK, Oakland, CA (Draft).

MAPS/DRAWINGS USED

RTK, 3/10/90. Top of Eagle Ford Shale and Austin Chalk, Drawing GE-2, prepared for U.S. Department of Energy Superconducting Super Collider.

RTK, 3/28/90. Drill Hole Location and Status, Drawing DL-2, prepared for U.S. Department of Energy Superconducting Super Collider.

RTK, 10/3/89. Tunnel Profile, Drawing TP-18, prepared for U.S. Department of Energy Superconducting Super Collider.

APPENDIX

Data List for Fracture Zones in Borings

BORING NUMBER	NORTH COORD	EAST COORD	GROUND ELEV	Depth of Formation Tops: TAYLOR MARL	AUSTIN CHALK	EAGLEFD SHALE	TOTAL DEPTH
B1527	248994.2	2172201.2	713.3		20.0	160.5	238.0
B1533	248576.0	2172058.0	729.6		0.5	170.2	255.0
B1540	250250.0	2171882.0	750.0		0.5	187.9	275.0
B20-89	264001.9	2167707.2	770.3		0.5	172.0	211.0
BE1	261640.3	2172255.6	679.0		4.2	106.1	212.0
BE10	225960.0	2181380.0	560.8		2.5		128.0
BE10.5	236330.0	2177010.0	645.6		14.5	179.4	215.0
BE10.7	238870.0	2175803.0	662.2		1.0	208.7	259.0
BE1-90	253843.0	2171122.0	763.1		2.0	196.0	257.4
BE1.7	269077.0	2172642.0	739.9		18.0	175.0	225.0
BE2	281050.0	2175688.0	674.1		0.5	134.1	211.0
BE3	298900.0	2197111.0	679.5		1.0	325	266.9
BE4	297829.0	2225784.0	549.8		30.0	442	287.0
BE5	278967.0	2245051.0	462.5	9.0	120.4	410	335.0
BE6	251280.0	2255023.0	484.2	4.0	308.5	↓	419.0
BE7A	222080.0	2249320.0	453.8	7.5	309.1	↓	350.0
BE8	206364.0	2224026.0	428.0	17.0	133.2	↓	220.0
BE9	207540.0	2200560.0	512.0		37.5	410	162.3
BF1	267430.0	2171093.0	727.7		1.0	143.6	221.0
BF10.1	246193.7	2174167.8	730.5		2.2	203.0	257.6
BF1.6	282039.0	2176960.0	627.6		1.0	98.3	152.7
BF2	291450.0	2184280.0	683.1		0.5	190.5	208.0
BF3	300776.0	2211027.0	548.4		20.0	293	208.0
BF6	238075.0	2255063.0	456.3	35.0	333.9	410	380.0
BF7	215426.0	2241756.0	483.3	6.3	300.3	↓	343.5
BF8	204307.0	2215118.0	512.2	2.5	112.5	↓	232.0
BF9	214885.0	2189515.0	543.3		16.0	410	167.5
BIR11	239029.0	2175454.0	670.2		1.0	217.4	265.0
BIR21	238620.0	2175708.0	665.3		1.0	212.6	312.6
BIR23	238320.0	2175840.0	659.9		2.0	208.5	241.0
BIR31	232079.0	2178422.0	617.5		2.4	165.0	295.2
BIR33	231772.0	2178541.0	616.4		1.4	169.3	204.0
BIR41	231388.0	2178618.0	618.7		4.0	175.0	226.0
BIR51	266212.0	2250535.0	449.0	20.0	180.7	410	200.0
BIR52	266420.0	2250682.0	447.8	24.5	186.3	↓	205.0
BIR54	266015.0	2250622.0	446.2	17.0	187.5	↓	421.6
BIR81	273893.0	2247359.0	452.2	12.5	140.4	↓	405.0
BIR82	273986.0	2247570.0	464.5	21.5	154.8	↓	197.0
BIR84	273653.0	2247464.0	446.8	14.0	136.1	410	179.0

continued on next page

Hand-written numbers are estimates from stratigraphic cross sections.

BORING NUMBER	NORTH COORD	EAST COORD	GROUND ELEV	TAYLOR MARL	AUSTIN CHALK	EAGLEFO SHALE	TOTAL DEPTH
BI-1	251717.0	2171756.0	741.4		0.5	183.0	211.0
BI-2A	256267.0	2179204.0	639.9		4.7	234.2	261.5
BI-3	246179.0	2180466.0	696.7		5.0	261.5	282.0
BI-4	255931.0	2174205.0	708.9		2.0	164.5	184.5
BI-5	251800.0	2182381.0	658.4		1.0	255.6	280.0
BI-6	245951.0	2174687.0	734.2		0.5	211.0	231.0
BK1'	241115.0	2175592.9	676.4		5.3	224.4	330.0
B-1	240640.5	2183759.2	674.0		5.0	300	102.0
B-5	259105.0	2242118.7	515.5	47.5	225	635	188.0
B-6	209588.7	2179248.2	489.8		17.2	63.0	100.0
B-C1			597.4		4.5		200.0
B-G1			496.7	21.0	53.0	455	200.0
B-RR	253585.1	2172953.9	747.5		3.0	195.0	205.0
B-XR	240513.6	2248291.6	502.0	46.0	275.5	410	342.0
E-4			536.4		33.7	444	150.4
E-9	209599.0	2196609.1	524.0		50.0	344	241.0
F-2	295670.1	2189648.9	725.8		4.5	267.3	288.8
F-3			548.3		29.7	388	164.1
F-4			496.7	54.2	71.7	482	150.5
F-6			426.7	16.0	307.0	410	327.0
F-7			477.7	23.0	243.0	↓	263.0
F-8			510.6	40.0	67.5	410	165.0
J-2	271108.8	2169156.4	768.3		1.0	190.0	209.0
J-3			564.2		9.0	133.0	152.0
J-4			516.2		41.0	131.3	162.0
J-6	232432.6	2178302.5	628.4		2.5	190.0	210.0
K-1	248998.3	2174321.6	747.9		1.4	216.2	250.5
K-2			760.2		2.5	201.5	224.6
K-3	276059.8	2246638.5	477.6	29.0	141.8	410	161.0
K-4			488.2	34.4	257.6		270.0
K-5	259042.1	2251676.7	496.2	19.5	259.0	↓	280.0
K-6			480.2	27.0	289.0	410	309.0
SE10.4	234498.0	2177791.9	643.1		0.5	190.5	225.0
SE10.8	240750.0	2174960.0	678.6		0.5	211.0	246.0
SE10.9A	242170.0	2175210.0	685.8		4.0	219.0	254.0
SE1.8	264930.0	2169240.0	740.5		1.0	149.9	217.9
SF8.6	206944.0	2206678.0	533.5	13.0	74.2	410	128.2
T-1	277881.6	2174731.6	704.2		1.3	182.2	200.0
T-3			579.4		0.4		100.0

Depth of Fracture Zones

BORING NUMBER	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM
B1527	120.9	123.2																
B1533	172.6	173.5	210.8	211.4														
B1540																		
B20-89	2.0	10.2	125.0	125.0	175.2	175.8	195.2	195.5	199.8	200.4								
BE1	9.5	13.4	49.6	49.9	62.0	62.4	108.4	111.4	120.5	121.0	123.0	123.8	125.7	126.9	136.2	142.1		
BE10	52.0	53.0																
BE10.5	200.0	200.5																
BE10.7	24.0	24.3	209.0	210.0	218.0	218.5	221.5	222.0										
BE1-90	11.2	12.5	21.9	22.6	126.6	127.5	148.9	149.9	200.4	203.8	212.4	213.8	217.9	221.4	223.9	225.0	245.1	245.7
BE1.7	18.0	27.8	33.6	33.7	116.4	118.0	120.3	121.2	175.9	176.2	177.8	178.0	180.2	183.7	206.1	206.8	221.5	221.8
BE2																		
BE3	22.0	23.4	26.3	30.4	31.6	33.5	38.4	53.0	56.5	56.9								
BE4																		
BE5	181.0	182.0	202.3	203.3	219.8	219.8	232.5	232.5	233.7	233.7	262.0	263.2						
BE6	302.0	307.5	371.5	372.7														
BE7A	29.2	30.3	37.2	37.8	87.9	90.9	107.2	107.5	110.7	111.9	115.2	115.5	140.6	143.3				
BE8	173.9	174.9																
BE9	122.0	123.2																
BF1	113.2	113.6																
BF10.1	2.5	8.6	145.8	147.4	208.5	209.5												
BF1.6	49.7	49.8	98.3	98.6	119.4	120.4	124.9	127.6	129.4	129.9	131.5	131.8	152.2	152.7				
BF2	140.0	140.4	161.7	162.4														
BF3	176.2	176.2																
BF6																		
BF7																		
BF8	174.9	178.0																
BF9	130.9	132.2	133.5	141.3	142.5	143.3	146.2	146.9										
BIR11	141.9	143.5	219.0	219.2	234.2	237.0	243.0	243.5	245.2	246.4	250.3	250.7	252.2	252.2	255.0	255.0	258.1	258.3
BIR21	177.5	177.5	215.6	215.7	231.8	232.2	236.8	236.8	242.3	243.0	244.2	247.8	252.6	253.1	261.3	261.3	263.4	264.0
BIR23	139.6	139.8	172.4	172.4	234.0	234.0												
BIR31	133.7	133.9	150.0	157.0														
BIR33																		
BIR41	110.8	111.6	176.1	176.4	179.9	179.9												
BIR51	169.4	171.2	196.2	196.2														
BIR52																		
BIR54	21.0	21.0	94.2	95.3	195.6	197.5	291.1	292.2	302.0	302.3								
BIR81	163.5	164.4																
BIR82																		
BIR84																		

continued on next page

BORING NUMBER	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM
BI-1	192.4	192.6																
BI-2A	164.2	164.2																
BI-3	77.0	78.8	80.4	82.2	85.8	94.5	263.7	267.0										
BI-4																		
BI-5	4.7	5.1	9.3	9.8	261.1	262.0	275.9	279.4										
BI-6	211.3	212.6																
BK1'	151.3	151.9	234.8	235.2	235.2	236.3	241.6	242.6	263.4	265.3	267.2	267.6	278.2	278.3	280.5	281.0	310.1	310.8
B-1	12.0	12.5	45.9	46.8														
B-5	178.5	179.3																
B-6																		
B-C1																		
B-G1	26.6	32.2																
B-RR	196.5	197.5	199.6	200.0														
B-XR	51.4	53.4																
E-4																		
E-9																		
F-2	72.1	72.4	196.7	197.5														
F-3																		
F-4	73.2	73.2	79.5	80.0	103.5	103.9												
F-6																		
F-7																		
F-8	126.2	126.7																
J-2																		
J-3	48.9	49.5	84.8	85.1	105.0	105.3	138.0	138.8	140.7	141.7								
J-4																		
J-6	193.7	194.4	208.0	209.0														
K-1																		
K-2	85.6	85.8	202.4	203.6	215.6	215.8												
K-3	91.4	92.1	99.0	99.2														
K-4																		
K-5																		
K-6																		
SE10.4					* CORES ONLY FROM 150 TO 225 FEET TD													
SE10.8					* CORES ONLY FROM 145 TO 246 FEET TD													
SE10.9A	173.2	175.1	238.4	240.0	* CORES ONLY FROM 160 TO 254 FEET TD													
SE1.8	9.2	10.9	152.7	155.0	157.9	158.6	177.2	180.2	184.7	185.5	205.1	206.3	207.6	208.7				
SF8.6	37.1	37.8	46.9	49.6														
T-1	187.9	188.7																
T-3																		

BORING NUMBER	FEET FRACTURED MARL	CHALK	SHALE	FEET DRILLED MARL	CHALK	SHALE
B1527		2.3			140.5	77.5
B1533			1.5		169.7	84.8
B1540					187.4	87.1
B20-89		8.2	1.5		171.5	39.0
BE1		4.6	11.4		101.9	105.9
BE10		1.0			125.5	
BE10.5			0.5		164.9	35.6
BE10.7		0.3	2.0		207.7	50.3
BE1-90		3.9	10.0		194.0	61.4
BE1.7		12.4	5.0		157.0	50.0
BE2					133.6	76.9
BE3		22.4			265.9	
BE4					257.0	
BE5		3.2		111.4	214.6	
BE6	5.5	1.2		304.5	110.5	
BE7A	9.2			301.6	40.9	
BE8		1.0		116.2	86.8	
BE9		1.2			124.8	
BF1		0.4			142.6	77.4
BF10.1		7.7	1.0		200.8	54.6
BF1.6		0.1	5.3		97.3	54.4
BF2		1.1			190.0	17.5
BF3		0.0			188.0	
BF6				298.9	46.1	
BF7				294.0	43.3	
BF8		3.1		110.0	119.5	
BF9		10.7			151.5	
BIR11		1.6	5.3		216.4	47.6
BIR21		0.0	5.9		211.6	100.0
BIR23		0.2	0.0		206.5	32.5
BIR31		7.2			162.6	130.2
BIR33					167.9	34.7
BIR41		0.8	0.3		171.0	51.0
BIR51	1.8	0.0		160.7	19.3	
BIR52				161.8	18.7	
BIR54	1.1	3.3		170.5	234.1	
BIR81		0.9		127.9	264.6	
BIR82				133.3	42.2	
BIR84				122.1	42.9	

BORING NUMBER	FEET FRACTURED MARL	CHALK	SHALE	FEET DRILLED MARL	CHALK	SHALE
BI-1			0.2		162.5	28.0
BI-2A		0.0			229.5	27.3
BI-3		12.3	3.3		256.5	20.5
BI-4					162.5	20.0
BI-5		0.9	4.4		254.6	24.4
BI-6			1.3		210.5	20.0
BK1'		0.6	6.1		220.4	105.6
B-1		1.4			97.0	
B-5	0.8			140.5		
B-6					45.8	37.0
B-C1					195.5	
B-61	5.6			32.0	147.0	
B-RR			1.4		192.0	10.0
B-XR	2.0			229.5	66.5	
E-4					116.7	
E-9					191.0	
F-2		1.1			262.8	21.5
F-3					134.4	
F-4		0.9		17.5	78.8	
F-6				291.0	20.0	
F-7				220.0	20.0	
F-8		0.5		27.5	97.5	
J-2					189.0	19.0
J-3		1.2	1.8		124.0	19.0
J-4					90.3	30.7
J-6			1.7		187.5	20.0
K-1					214.8	34.3
K-2		0.2	1.4		199.0	23.1
K-3	0.9			112.8	19.2	
K-4				223.2	12.4	
K-5				239.5	21.0	
K-6				262.0	20.0	
SE10.4					190.0	34.5
SE10.8					210.5	35.0
SE10.9A		1.9	1.6		215.0	35.0
SE1.8		1.7	9.1		148.9	68.0
SF8.6	3.4			61.2	54.0	
T-1			0.8		180.9	17.8
T-3					99.6	
	30.3	121.5	82.8	4269.5	11148.7	1919.1
	MARL	CHALK	SHALE	MARL	CHALK	SHALE
	TOTAL FEET FRACTURED			TOTAL FEET DRILLED		

PERCENT FRACTURED

MARL	CHALK	SHALE
0.71	1.09	4.31

BORING DEPTH REL TO TOP OF AUSTIN CHALK

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527									
B1533									
B1540									
B20-89									
BE1									
BE10									
BE10.5									
BE10.7									
BE1-90									
BE1.7									
BE2									
BE3									
BE4									
BE5	61.1	82.4	99.4	112.1	113.3	142.2			
BE6	-3.8	63.6							
BE7A	-279.3	-271.6	-219.7	-201.7	-197.8	-193.8	-167.1		
BE8	41.2								
BE9									
BF1									
BF10.1									
BF1.6									
BF2									
BF3									
BF6									
BF7									
BF8	64.0								
BF9									
BIR11									
BIR21									
BIR23									
BIR31									
BIR33									
BIR41									
BIR51	-10.4	15.5							
BIR52									
BIR54	-166.5	-92.8	9.0	104.2	114.7				
BIR81	23.5								
BIR82									
BIR84									

BORING DEPTH REL TO TOP OF AUSTIN CHALK

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1									
BI-2A									
BI-3									
BI-4									
BI-5									
BI-6									
BK1'									
B-1									
B-5									
B-6									
B-C1									
B-61	-23.6								
B-RR									
B-XR	-223.1								
E-4									
E-9									
F-2									
F-3									
F-4	1.5	8.0	32.0						
F-6									
F-7									
F-8	59.0								
J-2									
J-3									
J-4									
J-6									
K-1									
K-2									
K-3	-50.1	-42.7							
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A									
SE1.8									
SF8.6	-36.8		-26.0						
T-1									
T-3									

BORING DEPTH REL TO TOP OF EAGLE FORD SHALE MINUS 410 FT (APPROX TOP OF AUSTIN)

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527	371.6								
B1533	412.9	450.9							
B1540									
B20-89	244.1	363.0	413.5	433.4	439.1				
BE1	315.4	353.7	366.1	413.8	424.7	427.3	430.2	443.1	
BE10									
BE10.5	430.9								
BE10.7	225.5	410.8	419.6	423.1					
BE1-90	225.9	236.3	341.1	363.4	416.1	427.1	433.7	438.5	459.4
BE1.7	257.9	268.7	352.2	355.8	411.1	412.9	417.0	441.5	456.7
BE2									
BE3									
BE4									
BE5									
BE6									
BE7A									
BE8									
BE9									
BF1	379.8								
BF10.1	212.6	353.6	416.0						
BF1.6	361.5	410.2	431.6	438.0	441.4	443.4	464.2		
BF2	359.7	381.6							
BF3									
BF6									
BF7									
BF8									
BF9									
BIR11	335.3	411.7	428.2	435.9	438.4	443.1	444.8	447.6	450.8
BIR21	374.9	413.1	429.4	434.2	440.1	443.4	450.3	458.7	461.1
BIR23	341.2	373.9	435.5						
BIR31	378.8	398.5							
BIR33									
BIR41	346.2	411.3	414.9						
BIR51									
BIR52									
BIR54									
BIR81									
BIR82									
BIR84									

BORING DEPTH REL TO TOP OF EAGLE FORD SHALE MINUS 410 FT (APPROX TOP OF AUSTIN)

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1	419.5								
BI-2A	340.0								
BI-3	226.4	229.8	238.7	413.9					
BI-4									
BI-5	159.3	164.0	416.0	432.1					
BI-6	411.0								
BK1'	337.2	420.6	421.4	427.7	450.0	453.0	463.9	466.4	496.1
B-1									
B-5									
B-6									
B-C1									
B-G1									
B-RR	412.0	414.8							
B-XR									
E-4									
E-9									
F-2	215.0	339.8							
F-3									
F-4									
F-6									
F-7									
F-8									
J-2									
J-3	326.2	362.0	382.2	415.4	418.2				
J-4									
J-6	414.1	428.5							
K-1									
K-2	294.2	411.5	424.2						
K-3									
K-4									
K-5									
K-6									
SE10.4			219.5						
SE10.8			199.0						
SE10.9A	365.2	430.2	191.0						
SE1.8	270.2	414.0	418.4	438.8	445.2	465.8	468.3		
SF8.6									
T-1	416.1								
T-3									

BORING NUMBER	DEPTH TO MIDPOINT OF FRACTURE ZONE ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527	122.1								
B1533	173.1	211.1							
B1540									
B20-89	6.1	125.0	175.5	195.4	200.1				
BE1	11.5	49.8	62.2	109.9	120.8	123.4	126.3	139.2	
BE10	52.5								
BE10.5	200.3								
BE10.7	24.2	209.5	218.3	221.8					
BE1-90	11.9	22.3	127.1	149.4	202.1	213.1	219.7	224.5	245.4
BE1.7	22.9	33.7	117.2	120.8	176.1	177.9	182.0	206.5	221.7
BE2									
BE3	22.7	28.4	32.6	45.7	56.7				
BE4									
BE5	181.5	202.8	219.8	232.5	233.7	262.6			
BE6	304.8	372.1							
BE7A	29.8	37.5	89.4	107.3	111.3	115.3	141.9		
BE8	174.4								
BE9	122.6								
BF1	113.4								
BF10.1	5.6	146.6	209.0						
BF1.6	49.8	98.5	119.9	126.3	129.7	131.7	152.5		
BF2	140.2	162.1							
BF3	176.2								
BF6									
BF7									
BF8	176.5								
BF9	131.6	137.4	142.9	146.6					
BIR11	142.7	219.1	235.6	243.3	245.8	250.5	252.2	255.0	258.2
BIR21	177.5	215.7	232.0	236.8	242.7	246.0	252.9	261.3	263.7
BIR23	139.7	172.4	234.0						
BIR31	133.8	153.5							
BIR33									
BIR41	111.2	176.3	179.9						
BIR51	170.3	196.2							
BIR52									
BIR54	21.0	94.8	196.6	291.7	302.2				
BIR81	164.0								
BIR82									
BIR84									

BORING NUMBER	DEPTH TO MIDPOINT OF FRACTURE ZONE ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1	192.5								
BI-2A	164.2								
BI-3	77.9	81.3	90.2	265.4					
BI-4									
BI-5	4.9	9.6	261.6	277.7					
BI-6	212.0								
BK1'	151.6	235.0	235.8	242.1	264.4	267.4	278.3	280.8	310.5
B-1	12.3	46.4							
B-5	178.9								
B-6									
B-C1									
B-G1	29.4								
B-RR	197.0	199.8							
B-XR	52.4								
E-4									
E-9									
F-2	72.3	197.1							
F-3									
F-4	73.2	79.8	103.7						
F-6									
F-7									
F-8	126.5								
J-2									
J-3	49.2	85.0	105.2	138.4	141.2				
J-4									
J-6	194.1	208.5							
K-1									
K-2	85.7	203.0	215.7						
K-3	91.8	99.1							
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A	174.2	239.2							
SE1.8	10.1	153.9	158.3	178.7	185.1	205.7	208.2		
SF8.6	37.5	48.3							
T-1	188.3								
T-3									

BORING NUMBER	WIDTH OF FRACTURE ZONE ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527	2.3								
B1533	0.9	0.6							
B1540									
B20-89	8.2		0.6	0.3	0.6				
BE1	3.9	0.3	0.4	3.0	0.5	0.8	1.2	5.9	
BE10	1.0								
BE10.5	0.5								
BE10.7	0.3	1.0	0.5	0.5					
BE1-90	1.3	0.7	0.9	1.0	3.4	1.4	3.5	1.1	0.6
BE1.7	9.8	0.1	1.6	0.9	0.3	0.2	3.5	0.7	0.3
BE2									
BE3	1.4	4.1	1.9	14.6	0.4				
BE4									
BE5	1.0	1.0				1.2			
BE6	5.5	1.2							
BE7A	1.1	0.6	2.9	0.3	1.2	0.3	2.8		
BE8	1.0								
BE9	1.2								
BF1	0.4								
BF10.1	6.1	1.6	1.0						
BF1.6	0.1	0.3	1.0	2.7	0.5	0.3	0.5		
BF2	0.4	0.7							
BF3									
BF6									
BF7									
BF8	3.1								
BF9	1.3	7.9	0.9	0.7					
BIR11	1.6	0.2	2.8	0.5	1.2	0.4			0.2
BIR21		0.1	0.4		0.7	3.6	0.5		0.6
BIR23	0.2								
BIR31	0.2	7.0							
BIR33									
BIR41	0.8	0.3							
BIR51	1.8								
BIR52									
BIR54		1.1	1.9	1.1	0.3				
BIR81	0.9								
BIR82									
BIR84									

BORING NUMBER	WIDTH OF FRACTURE ZONE ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1	0.2								
BI-2A									
BI-3	1.8	1.8	8.7	3.3					
BI-4									
BI-5	0.4	0.5	0.9	3.5					
BI-6	1.3								
BK1'	0.6	0.4	1.1	1.0	1.9	0.4	0.1	0.5	0.7
B-1	0.5	0.9							
B-5	0.8								
B-6									
B-C1									
B-G1	5.6								
B-RR	1.0	0.4							
B-XR	2.0								
E-4									
E-9									
F-2	0.3	0.8							
F-3									
F-4		0.5	0.4						
F-6									
F-7									
F-8	0.5								
J-2									
J-3	0.6	0.3	0.3	0.8	1.0				
J-4									
J-6	0.7	1.0							
K-1									
K-2	0.2	1.2	0.2						
K-3	0.7	0.2							
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A	1.9	1.6							
SE1.8	1.7	2.3	0.7	3.0	0.8	1.2	1.1		
SF8.6	0.7	2.7							
T-1	0.8								
T-3									

BORING	N	E	GR.EL.	TAYLOR	AUSTIN	EAGLE	TD	SLANT FEET DRILLED.....			
								MARL	CHALK	SHALE	TOTAL ROCK
BIR12	239008.0	2175582.0	667.5		2.5	304.6	341.5		302.1	36.9	339.0
BIR22	238494.0	2175935.0	658.4		0.5	286.7	357.0		286.2	70.3	356.5
BIR32	231944.0	2178644.0	618.5		6.0	220.6	293.7		214.6	73.1	287.7
BIR42	231357.0	2178714.0	620.0		1.5	245.2	282.5		243.7	37.3	281.0
BIR53	266088.0	2250927.0	438.7	16.5	238.7		285.5	222.2	46.8		269.0
BIR83	273755.7	2247677.8	454.8	8.0	205.9		285.7	197.9	79.8		277.7
SE1	261548.2	2172406.1	696.2		0.5	166.4	286.0		165.9	119.6	285.5
SE10.9C	240950.5	2174744.1	684.0		3.5	286.5	343.5		283.0	57.0	340.0
SE10.9D	240907.0	2174765.0	683.2		3.5	276.5	354.5		273.0	78.0	351.0
SE5.2E	277945.0	2245580.0	495.0	12.5	203.5		315.0	191.0	111.5		302.5
SF10.1C	247047.0	2173209.0	718.3		0.0	269.1	344.0		269.1	74.9	344.0
SI2C	256049.0	2178907.0	655.0		14.4		266.5		252.1		252.1
SIR3B	232246.0	2178195.0	617.8		3.0	259.6	372.0		256.6	112.4	369.0
							TOTAL	611.1	2784.4	659.5	4055.0

	DEVIATION SURVEY.....				BORING LOG.....				SLANT FEET FRACTURED.....		
	CABLE DEPTH		TRUE DEPTH		CABLE DEPTH		TRUE DEPTH				
BORING	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	MARL	CHALK	SHALE
SE5.2E	70	90	68.59	84.08	52.6	53.3	55.1	55.7	0.7		
	70	90	68.59	84.08	59.0	60.4	60.1	61.2	1.4		
	70	90	68.59	84.08	61.8	62.5	62.2	62.8	0.7		
	67	69	66.25	67.81	67.4	68.2	66.6	67.2	0.8		
	70	72	68.59	70.15	70.7	72.0	69.1	70.2	1.3		
	75	77	72.48	74.03	75.5	76.6	72.9	73.7	1.1		
	217	219	184.92	186.56	217.1	218.2	185.0	185.9		1.1	
	242	243	205.47	206.29	242.4	243.0	205.8	206.3		0.6	
	258	260	218.65	220.30	258.5	259.2	219.1	219.6		0.7	
	282	283	238.49	239.32	282.4	282.7	238.8	239.1		0.3	
	284	286	240.16	241.81	284.4	285.4	240.5	241.3		1	
	304	306	256.74	258.41	304.6	305.7	257.2	258.2		1.1	
	292	312	246.79	263.39	315.0		265.9				
SIR3B	75	76	61.43	62.20	75.4	75.7	61.7	62.0		0.3	
	82	84	66.80	68.34	82.8	83.1	67.4	67.6		0.3	
	85	87	69.11	70.66	85.2	86.5	69.3	70.3		1.3	
	123	124	98.58	99.36	123.7	123.8	99.1	99.2		0.1	
	219	220	174.41	175.20	219.2	219.6	174.6	174.9		0.4	
	250	252	199.21	200.81	250.2	251.8	199.4	200.7		1.6	
	265	267	211.27	212.89	265.8	266.4	211.9	212.4			0.6
	270	275	215.29	219.34	270.6	274.2	215.8	218.7			3.6
	261	281	208.05	224.19	284.4	286.7	226.9	228.8			2.3
	181	281	144.21	224.19	372.0		297.0				
SF10.1C	29	30	22.59	23.34	29.0	30.0	22.6	23.3		1	
	46	48	35.29	36.78	46.8	47.9	35.9	36.7		1.1	
	79	81	59.99	61.50	79.2	80.3	60.1	61.0		1.1	
	87	88	66.03	66.78	87.1	87.2	66.1	66.2		0.1	
	90	94	68.29	71.32	90.8	93.4	68.9	70.9		2.6	
	98	101	74.33	76.61	98.4	100.5	74.6	76.2		2.1	
	148	151	112.59	114.89	148.6	150.9	113.1	114.8		2.3	
	172	176	131.02	134.09	172.9	176.0	131.7	134.1		3.1	
	179	180	136.39	137.16	179.0	179.6	136.4	136.9		0.6	
	252	253	192.45	193.21	252.6	252.9	192.9	193.1		0.3	
	257	259	196.28	197.82	257.7	258.8	196.8	197.7		1.1	
	261	264	199.35	201.65	261.9	264.0	200.0	201.7		2.1	
	265	267	202.41	203.94	265.4	267.0	202.7	203.9		1.6	
	274	281	209.31	214.68	274.4	280.1	209.6	214.0			5.7
	284	285	216.99	217.76	284.0	284.2	217.0	217.1			0.2
	285	293	217.76	223.92	285.4	292.6	218.1	223.6			7.2
	295	297	225.45	226.99	295.0	296.8	225.5	226.8			1.8
	302	303	230.85	231.63	302.0	302.1	230.9	230.9			0.1
	303	304	231.63	232.41	303.3	303.7	231.9	232.2			0.4
	305	306	233.18	233.96	305.0	305.8	233.2	233.8			0.8
	323	343	247.18	262.71	344.0		263.5				

	DEVIATION SURVEY.....				BORING LOG.....				SLANT FEET FRACTURED.....		
	CABLE DEPTH		TRUE DEPTH		CABLE DEPTH		TRUE DEPTH				
BORING	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	MARL	CHALK	SHALE
SE10.9D	177	179	133.80	135.34	177.6	179.0	134.3	135.3		1.4	
	182	183	137.62	138.37	182.2	182.5	137.8	138.0		0.3	
	324	344	244.57	259.33	354.5		267.1				
SE10.9C	96	97	74.64	75.41	96.2	96.6	74.8	75.1		0.4	
	99	100	76.96	77.74	99.4	99.6	77.3	77.4		0.2	
	285	287	221.26	222.81	285.7	286.5	221.8	222.4		0.8	
	288	314	223.58	243.70	288.0	313.6	223.6	243.4			25.6
	316	318	245.27	246.82	316.0	317.5	245.3	246.4			1.5
	320	321	248.37	249.14	320.8	320.9	249.0	249.1			0.1
	322	326	249.91	252.99	322.8	325.7	250.5	252.8			2.9
	327	343	253.74	266.21	327.0	343.0	253.7	266.2			16
	333	343	258.41	266.21	343.5		266.6				
BIR53	254	274	194.07	209.17	278.8	278.9	212.8	212.9		0.1	
	244	274	186.41	209.17	285.5		217.9				
BIR42	269	273	194.24	197.15	269.6	272.1	194.7	196.5			2.5
	273	275	197.15	198.59	273.5	274.3	197.5	198.1			0.8
	271	281	195.69	202.97	282.5		204.1				
BIR32	192	193	147.75	148.52	192.7	192.9	148.3	148.4		0.2	
	196	197	150.82	151.59	196.5	196.6	151.2	151.3		0.1	
	280	290	215.58	223.24	293.7		226.1				
SE1	3	7	3.00	7.00	3.5	6.3	3.5	6.3		2.8	
	10	11	9.61	10.40	10.3	10.9	9.8	10.3		0.6	
	23	24	19.79	20.57	23.1	23.4	19.9	20.1		0.3	
	82	84	65.60	67.14	82.3	83.1	65.8	66.4		0.8	
	92	94	73.28	74.82	92.5	93.3	73.7	74.3		0.8	
	96	100	76.35	79.44	96.4	99.8	76.7	79.3		3.4	
	169	171	132.83	134.38	169.0	170.1	132.8	133.7			1.1
	242	272	189.05	212.20	286.0		223.0				
BIR22	3	5	3.00	5.00	3.8	4.2	3.8	4.2		0.4	
	5	7	5.00	6.66	5.4	6.6	5.3	6.3		1.2	
	15	17	12.47	13.92	15.8	16.6	13.1	13.6		0.8	
	141	143	102.64	104.09	141.2	142.8	102.8	103.9		1.6	
	239	240	174.10	174.83	239.5	239.6	174.5	174.5		0.1	
	356	357	259.71	260.44	357.0		260.4				
BIR83	274	284	197.40	204.58	285.7		205.8				
BIR12	195	199	139.87	142.70	195.8	198.5	140.4	142.3		2.7	
	249	250	178.23	178.94	249.6	249.7	178.7	178.7		0.1	
	269	270	191.70	193.13	268.2	269.4	190.6	192.3		1.2	
	341	342	243.02	243.72	341.5		243.4				

	DEVIATION SURVEY.....				BORING LOG.....				SLANT FEET FRACTURED.....		
	CABLE DEPTH		TRUE DEPTH		CABLE DEPTH		TRUE DEPTH				
BORING	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	MARL	CHALK	SHALE
SI2C	245	265	194.50	210.07	266.5		211.2				

	MARL	CHALK	SHALE
SUM	6.0	48.2	73.2
COUNT	6	47	18
MAX	1.4	3.4	25.6
MEAN	1.0	1.0	4.1
MIN	0.7	0.1	0.1
STD.DEV	0.3	0.9	6.4
% FRACTURED	1.0	1.7	11.1

WIDTH DISTRIBUTION.....

	MARL		CHALK		SHALE	TOTAL
WIDTH	NO.	WIDTH	NO.	WIDTH	NO.	NO.
0.5	0	0.5	17	0.5	4	21
1	3	1	10	1	3	16
1.5	3	1.5	9	1.5	2	14
2	0	2	3	2	1	4
2.5	0	2.5	3	2.5	2	5
3	0	3	3	3	1	4
3.5	0	3.5	2	3.5	0	2
4	0	4	0	4	1	1
4.5	0	4.5	0	4.5	0	0
5	0	5	0	5	0	0
5.5	0	5.5	0	5.5	0	0
6	0	6	0	6	1	1
6.5	0	6.5	0	6.5	0	0
7	0	7	0	7	0	0
7.5	0	7.5	0	7.5	1	1
8	0	8	0	8	0	0
8.5	0	8.5	0	8.5	0	0
9	0	9	0	9	0	0
9.5	0	9.5	0	9.5	0	0
10	0	10	0	10	0	0
10.5	0	10.5	0	10.5	0	0
11	0	11	0	11	0	0
11.5	0	11.5	0	11.5	0	0
12	0	12	0	12	0	0
12.5	0	12.5	0	12.5	0	0
13	0	13	0	13	0	0
13.5	0	13.5	0	13.5	0	0
14	0	14	0	14	0	0
14.5	0	14.5	0	14.5	0	0
15	0	15	0	15	0	0
	0		0		2	2

BORING CORE DISKING ZONE DEPTHS

NUMBER	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM
B1527																				
B1533																				
B1540	74.0	76.0	82.0	85.0	91.0	93.0	115.0	116.0	128.0	129.0	135.0	136.5	142.0	145.0						
B20-89	none																			
BE1	none																			
BE10	none																			
BE10.5	86.3	87.9	181.0	182.0																
BE10.7	110.9	111.4	146.9	147.4	178.2	179.2														
BE1-90	none																			
BE1.7	155.5	165.0	205.0	206.0																
BE2	145.0	146.7	160.0	161.0	190.0	196.0	200.0	206.0												
BE3	121.0	123.0	126.0	129.0	174.5	175.5	186.5	189.5	212.5	214.5	216.0	217.0	217.5	221.5						
BE4	30.0	43.0	75.0	78.0																
BE5	none																			
BE6	395.0	409.0																		
BE7A	62.5	69.0	88.0	90.0	99.0	100.0	133.0	137.0	150.0	155.0	229.0	230.0	332.0	335.0	338.0	347.0	348.0	350.0		
BE8	80.0	81.0	134.0	136.0	168.0	170.0	191.0	201.0												
BE9	none																			
BF1	none																			
BF10.1	117.0	117.5	251.0	254.0																
BF1.6																				
BF2	1.0	3.0	141.0	150.0	170.0	180.0														
BF3																				
BF6	40.0	42.0	60.0	64.0	70.0	78.0	90.0	92.0	122.0	138.0	183.0	190.0	202.0	210.0	272.0	297.0				
BF7	none																			
BF8	none																			
BF9	139.0	140.0																		
BIR11	none																			
BIR21	none																			
BIR23																				
BIR31																				
BIR33																				
BIR41	none																			
BIR51																				
BIR52																				
BIR54	none																			
BIR81	173.0	173.8	177.0	177.7	181.5	182.9	188.0	188.7	201.0	202.2	219.0	219.4								
BIR82																				
BIR84																				

BORING CORE DISKING ZONE DEPTHS

NUMBER	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM	TOP	BOTTOM
BI-1	171.0	174.0																
BI-2A																		
BI-3	105.5	107.0	124.0	127.0														
BI-4	34.5	38.0	40.0	42.0	121.3	122.1	152.3	154.0										
BI-5	96.0	97.0	99.2	100.2	111.0	112.3	122.2	123.3	124.5	130.0	139.0	140.3	211.3	218.8	236.0	238.3		
BI-6	112.8	113.6	117.0	117.4	171.8	174.3	183.0	186.0										
BK1'	none																	
B-1																		
B-5																		
B-6																		
B-C1																		
B-G1																		
B-RR																		
B-XR																		
E-4																		
E-9																		
F-2																		
F-3																		
F-4																		
F-6																		
F-7																		
F-8																		
J-2																		
J-3																		
J-4																		
J-6																		
K-1																		
K-2																		
K-3																		
K-4																		
K-5																		
K-6																		
SE10.4																		
SE10.8																		
SE10.9A																		
SE1.8	180.4	181.3																
SF8.6	none																	
T-1																		
T-3																		

BORING DISK ZONE DEPTHS REL TO TOP OF AUSTIN CHALK

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527									
B1533									
B1540									
B20-89									
BE1									
BE10									
BE10.5									
BE10.7									
BE1-90									
BE1.7									
BE2									
BE3									
BE4									
BE5									
BE6	93.5								
BE7A	-243.3	-220.1	-209.6	-174.1	-156.6	-79.6	24.4	33.4	39.9
BE8	-52.7	1.8	35.8	62.8					
BE9									
BF1									
BF10.1									
BF1.6	OS								
BF2									
BF3	OS								
BF6	-292.9	-271.9	-259.9	-242.9	-203.9	-147.4	-127.9	-49.4	
BF7									
BF8									
BF9									
BIR11									
BIR21									
BIR23									
BIR31									
BIR33									
BIR41									
BIR51									
BIR52									
BIR54									
BIR81	33.0	36.9	41.8	47.9	61.2	78.8			
BIR82									
BIR84									

BORING DISK ZONE DEPTHS REL TO TOP OF AUSTIN CHALK

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1									
BI-2A									
BI-3									
BI-4									
BI-5									
BI-6									
BK1'									
B-1									
B-5									
B-6									
B-C1									
B-G1									
B-RR									
B-XR									
E-4									
E-9									
F-2									
F-3									
F-4									
F-6									
F-7									
F-8									
J-2									
J-3									
J-4									
J-6									
K-1									
K-2									
K-3									
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A									
SE1.8									
SF8.6									
T-1									
T-3									

BORING DISK ZONE DEPTHS REL TOP OF EAGLE FORD SHALE (APPROX TOP AUSTIN)

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527									
B1533									
B1540	297.1	305.6	314.1	337.6	350.6	357.9	365.6		
B20-89									
BE1									
BE10									
BE10.5	317.7	412.1							
BE10.7	312.5	348.5	380.0						
BE1-90									
BE1.7	395.3	440.5							
BE2	421.8	436.4	468.9	478.9					
BE3									
BE4									
BE5									
BE6									
BE7A									
BE8									
BE9									
BF1									
BF10.1	324.3	459.5							
BF1.6									
BF2	221.5	365.0	394.5						
BF3									
BF6									
BF7									
BF8									
BF9									
BIR11									
BIR21									
BIR23									
BIR31									
BIR33									
BIR41									
BIR51									
BIR52									
BIR54									
BIR81									
BIR82									
BIR84									

BORING DISK ZONE DEPTHS REL TOP OF EAGLE FORD SHALE (APPROX TOP AUSTIN)

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1	399.5								
BI-2A									
BI-3	254.8	274.0							
BI-4	281.8	286.5	367.2	398.7					
BI-5	250.9	254.1	266.1	277.2	281.7	294.1	369.5	391.6	
BI-6	312.2	316.2	372.1	393.5					
BK1'									
B-1									
B-5									
B-6									
B-C1									
B-61									
B-RR									
B-XR									
E-4									
E-9									
F-2									
F-3									
F-4									
F-6									
F-7									
F-8									
J-2									
J-3									
J-4									
J-6									
K-1									
K-2									
K-3									
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A									
SE1.8	441.0								
SF8.6									
T-1									
T-3									

BORING WIDTH OF DISK ZONES

NUMBER	ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
B1527									
B1533									
B1540	2.0	3.0	2.0	1.0	1.0	1.5	3.0		
B20-89									
BE1									
BE10									
BE10.5	1.6	1.0							
BE10.7	0.5	0.5	1.0						
BE1-90									
BE1.7	9.5	1.0							
BE2	1.7	1.0	6.0	6.0					
BE3									
BE4									
BE5									
BE6	14.0								
BE7A	6.5	2.0	1.0	4.0	5.0	1.0	3.0	9.0	2.0
BE8	1.0	2.0	2.0	10.0					
BE9									
BF1									
BF10.1	0.5	3.0							
BF1.6									
BF2	2.0	9.0	10.0						
BF3									
BF6	2.0	4.0	8.0	2.0	16.0	7.0	8.0	25.0	
BF7									
BF8									
BF9	1.0								
BIR11									
BIR21									
BIR23									
BIR31									
BIR33									
BIR41									
BIR51									
BIR52									
BIR54									
BIR81	0.8	0.7	1.4	0.7	1.2	0.4			
BIR82									
BIR84									

BORING NUMBER	WIDTH OF DISK ZONES ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9
BI-1	3.0								
BI-2A									
BI-3	1.5	3.0							
BI-4	3.5	2.0	0.8	1.7					
BI-5	1.0	1.0	1.3	1.1	5.5	1.3	7.5	2.3	
BI-6	0.8	0.4	2.5	3.0					
BK1'									
B-1									
B-5									
B-6									
B-C1									
B-G1									
B-RR									
B-XR									
E-4									
E-9									
F-2									
F-3									
F-4									
F-6									
F-7									
F-8									
J-2									
J-3									
J-4									
J-6									
K-1									
K-2									
K-3									
K-4									
K-5									
K-6									
SE10.4									
SE10.8									
SE10.9A									
SE1.8	0.9								
SFB.6									
T-1									
T-3									

DISTRIBUTION OF DISK-ZONE WIDTHS

DEPTH	NO.
-250.0	3.0
-200.0	5.0
-150.0	2.0
-100.0	2.0
-50.0	2.0
0.0	1.0
50.0	9.0
100.0	4.0
150.0	0.0
200.0	0.0
250.0	1.0
300.0	11.0
350.0	9.0
400.0	14.0
450.0	5.0
500.0	3.0
	0.0
SUM	71.0

BORING NUMBER	WIDTH OF DISK ZONES ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9	SUM OF ZONES	DISKING WIDTHS MARL	CHALK SHALE
B1527												
B1533												
B1540	2.0	3.0	2.0	1.0	1.0	1.5	3.0			13.5		13.5
B20-89	none											
BE1	none											
BE10	none											
BE10.5	1.6	1.0								2.6		2.6
BE10.7	0.5	0.5	1.0							2.0		2.0
BE1-90	none											
BE1.7	9.5	1.0								10.5		10.5
BE2	1.7	1.0	6.0	6.0						14.7		14.7
BE3												
BE4												
BE5	none											
BE6	14.0									14.0		14.0
BE7A	6.5	2.0	1.0	4.0	5.0	1.0	3.0	9.0	2.0	33.5	19.5	14.0
BE8	1.0	2.0	2.0	10.0						15.0	1.0	14.0
BE9	none											
BF1	none											
BF10.1	0.5	3.0								3.5		3.5
BF1.6												
BF2	2.0	9.0	10.0							21.0		21.0
BF3												
BF6	2.0	4.0	8.0	2.0	16.0	7.0	8.0	25.0		72.0	72.0	72.0
BF7	none											
BF8	none											
BF9	1.0									1.0		1.0
BIR11	none											
BIR21	none											
BIR23												
BIR31												
BIR33												
BIR41	none											
BIR51												
BIR52												
BIR54	none											
BIR81	0.8	0.7	1.4	0.7	1.2	0.4				5.2		5.2
BIR82												
BIR84												

BORING NUMBER	WIDTH OF DISK ZONES ZONE 1	ZONE 2	ZONE 3	ZONE 4	ZONE 5	ZONE 6	ZONE 7	ZONE 8	ZONE 9	SUM OF ZONES	DISKING WIDTHS MARL	CHALK	SHALE
BI-1	3.0									3.0		3.0	
BI-2A													
BI-3	1.5	3.0								4.5		4.5	
BI-4	3.5	2.0	0.8	1.7						8.0		8.0	
BI-5	1.0	1.0	1.3	1.1	5.5	1.3	7.5	2.3		21.0		21.0	
BI-6	0.8	0.4	2.5	3.0						6.7		6.7	
BK1'	none												
B-1													
B-5													
B-6													
B-C1													
B-61													
B-RR													
B-XR													
E-4													
E-9													
F-2													
F-3													
F-4													
F-6													
F-7													
F-8													
J-2													
J-3													
J-4													
J-6													
K-1													
K-2													
K-3													
K-4													
K-5													
K-6													
SE10.4													
SE10.8													
SE10.9A													
SE1.8	0.9									0.9		0.9	
SF8.6	none												
T-1													
T-3													
COUNT	72.0								TOTAL	252.6	92.5	232.1	

BORING NUMBER	THICKNESS OF WEATHERING MARL	CHALK	SHALE
B1527		10.4	
B1533		15.8	
B1540		12.3	
B20-89		9.7	
BE1		6.8	
BE10		2.2	
BE10.5		3.3	
BE10.7		3.5	
BE1-90		11.4	
BE1.7		9.9	
BE2		9.2	
BE3		32.5	
BE4		13.3	
BE5	6.0		
BE6	12.0		
BE7A	31.3		
BE8	14.3		
BE9		4.3	
BF1		14.6	
BF10.1		13.0	
BF1.6		1.9	
BF2		7.5	
BF3		2.1	
BF6			
BF7	44.0		
BF8	33.5		
BF9		12.8	
BIR11		2.0	
BIR21		3.0	
BIR23		12.4	
BIR31		15.1	
BIR33		11.1	
BIR41		12.0	
BIR51	4.5		
BIR52			
BIR54	5.0		
BIR81	8.5		
BIR82	8.5		
BIR84	12.0		

BORING NUMBER	THICKNESS OF WEATHERING MARL	CHALK	SHALE	
BI-1		6.7		
BI-2A		3.1		
BI-3		7.2		
BI-4		12.9		
BI-5		9.0		
BI-6		20.9		
BK1'		1.3		
B-1		12.0		
B-5	3.5			
B-6		4.5		
B-C1		3.0		
B-G1	12.0			
B-RR		6.5		
B-XR	14.0			
E-4		4.8		
E-9				
F-2		11.3		
F-3		1.0		
F-4	8.1			
F-6	3.5			
F-7	37.0			
F-8				
J-2		16.0		
J-3		9.0		
J-4				
J-6		3.0		
K-1		6.1		
K-2		12.4		
K-3	5.0			
K-4	5.6			
K-5	14.5			
K-6	8.0			
SE10.4		12.0		
SE10.8		7.5		
SE10.9A		4.0		
SE1.8		28.8		
SF8.6	36.6			
T-1		10.4		
T-3		5.9		
	25	53		COUNT
	13.1	8.9		MEAN
	12.6	6.5		STD.DEV